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| 10/569,838 | 12/01/2006 | Hiroyuki Kano | F06-436-US | 3074 |

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| EXAMINER | |
|---|---|
| LOUIE, MANDY C | |

| ART UNIT | PAPER NUMBER |
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| 1792 | |

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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/569,838 | KANO ET AL. | |
| | Examiner | Art Unit | |
| | MANDY C. LOUIE | 1792 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *12 August 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *38-74* is/are pending in the application.

4a) Of the above claim(s) *46-53 and 65-74* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *38-45 and 54-64* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *04/23/07, 12/27/06, 02/24/06*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

### *Election/Restrictions*

1. Applicant's election of group I, claims 38-45, 54-64 in the reply filed on 08/12/09 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

### *Claim Rejections - 35 USC § 112*

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claim 59 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

a. Regarding claim 59, it is unclear as to what "one of the steps" is being referred, for the purpose of examination, it is interpreted that "one of the steps" is referring to the steps of method 38 (i.e. creating and introducing).

### *Claim Rejections - 35 USC § 102*

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 38-42, 44, 55, 57, 60 are rejected under 35 U.S.C. 102(b) as being anticipated by Hiramatsu [The 16th symposium abstract: Fabrication of carbon nanowalls using RF plasma CVD].

It is noted that the date provided for the 16$^{th}$ symposium is 4~5 June 2003 on the front page of the prior art document.

Regarding claim 38, Hiramatsu teaches a method for producing carbon nanowalls [title] comprising creating a plasma atmosphere in at least one region of a reaction chamber (main chamber) by plasmatizing a source material containing carbon; introducing radicals generated outside (remote source) the plasma atmosphere into the plasma atmosphere (i.e. reaction chamber); and growing carbon nanowalls on a base material (substrate) disposed in the reaction chamber [pg 20].

Regarding claim 39, although the prior art does not explicitly teach generating the radicals by decomposition, it would have been inherent to the prior art that in order to provide hydrogen (H) radicals from an inductively coupled $H_2$ plasma [pg 20, col 1], the $H_2$ source would decompose from $H_2$ to H radicals.

Regarding claim 40, Hiramatsu teaches the radicals are generated by RF waves to the radical source [pg 20, col 1].

Regarding claim 41, Hiramatsu teaches the radicals include hydrogen radicals [pg 20, col 1].

Regarding claim 42, again, although the prior art does not explicitly teach generating the radicals by decomposition, it would have been inherent to the prior art that in order to provide hydrogen (H) radicals from an inductively coupled $H_2$ plasma [pg 20, col 1], the $H_2$ source would decompose from $H_2$ to H radicals. Hiramatsu further teaches introducing the radicals into the plasma atmosphere (i.e. reaction chamber).

Regarding claim 44, Hiramatsu teaches the source material contains carbon and fluorine [pg 20, col 1].

Regarding claim 54, Hiramatsu teaches the carbon nanowalls are successfully deposited on a silicon (100) substrate [pg 20] without indication of critically using metal catalyst on the substrate to generate such structures from the process; hence, it would have been inherent that such substrate would have no metal catalyst.

Regarding claim 55, Hiramatsu teaches the source material contains at least one of carbon, hydrogen, and fluorine that are essential components [pg 20].

Regarding claim 57, Hiramatsu teaches the source material is at least one of $C_2F_6$ and $CF_4$ [pg 20].

Regarding claim 60, Hiramatsu teaches the introduced radicals are H radicals from a inductively coupled $H_2$ plasma to the reaction chamber in a closed system [pg 20] without indications of critically providing an oxygen source; hence, it would have inherent to the prior art that such radicals would include no OH radicals.

***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 43, 56 and 58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hiramatsu in view of Nagasawa [US 2002/0072249].

Teaching of Hiramatsu is aforementioned, but appears to be silent in teaching the limitations of claims 43, 56 and 58. Nagasawa remedies this.

Regarding claims 43, 56 and 58, Nagasawa teaches forming a carbon containing film (i.e. silicon carbide) on a substrate [abstract], wherein the prior art teaches the carbon gas source for forming the film may be at least one of $CH_4$ (carbon and hydrogen), $CHF_3$, $CF_4$ [0075]. Such that, it would have been obvious to one of ordinary skill in the art at the time of the invention to either use $CH_4$, $CHF_3$, $CF_4$ as a carbon gas source as suggested by Nagasawa, since either one of these gases may be operable equivalents for carbon gases sources in forming a carbon film. It is also noted by the examiner that it is well known in the art that methane is a common carbon precursor for carbon structures.

5. Claims 45 and 63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hiramatsu in view of Kirimura [US 6383896].

Teaching of Hiramatsu is aforementioned, but appears to be silent in teaching the feed rate of radicals is controlled on the basis of concentration of hydrogen radicals and pretreating the base material by apply the radicals to the base material before plasmatizing the source material. Kirimura remedies this.

Regarding claim 45, Kirimura teaches controlling the amount of neutral radicals or feed rate of the source material emitted to the substrate [abstract] to form a high quality film with minimal plasma damage [col 2, ln 45-54] by controlling the concentration (density) of hydrogen radicals [col 9, ln 15-34].

It would have been obvious to one of ordinary skill in the art at the time of the invention to control the feed rate of the source material or feed rate based upon the concentration of radicals as suggested by Kimura. One would have been motivated to do so to yield a desirable, high quality film while reducing plasma damages [Kimura, col 9, ln 30-40].

Regarding claim 63, Hiramatsu in view of Kimura further teaches pretreating the base material by apply the radicals to the base material before plasmatizing the source material [col 6, ln 56-65].

It would have been obvious to one of ordinary skill in the art at the time of the invention to pretreat the base by applying the radicals before plasmatizing the source material as suggested by Kimura. One would have been motivated to do so in order to improve the interface between the substrate and the coating [Kimura, col 6, ln 56-65].

6. Claim 59 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hiramatsu in view of Nagasawa and further in view of Ravi [US 6548313].

Teaching of Hiramatsu is aforementioned, but appears to be silent in teaching at least two of the gases are alternatively switched in any one of the steps. Ravi remedies this.

Regarding claim 59, Ravi teaches a carbon structure (carbon nanotube) be subjected to a plasma with a processing gas of hydrogen or fluorine [col 6, ln 35-56]. Although the prior at does not explicitly teach at least two of the gases are alternatively switched, since the prior art does teaches $CH_4$, $CHF_3$, $CF_4$ may be obvious variants [Nagasawa, 0075] and that hydrogen or fluorine may be used for generating plasma

(i.e. for forming radicals) [Ravi, col 6, ln 35-56] also as operable equivalents, it would have been obvious to one of ordinary skill in the art that such gases taught by the prior art would be capable of being switched for either as a carbon source or plasma source. Moreover it would have been apparent to one of ordinary skill in the art that such gases would in part be switched during film formation since the plasma would generate radicals of both the carbon source and radical source to form the coating.

It would have been obvious to one of ordinary skill in the art to use either taught gases for a carbon source or plasma source. One would have been motivated to do so in order to ensure carbon and plasma radicals would be generated to form the desired coating film.

7. Claim 61 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hiramatsu in view of Kirimura and further in view of Chang [US 5627640].

Teaching of Hiramatsu in view of Kirimura is aforementioned, but appears to be silent in measuring the amount of radicals introduced. Chang remedies this.

Regarding claim 61, Chang teaches a method for measuring radical species distribution in plasma [abstract].

It would have been obvious to one of ordinary skill in the art at the time of the invention to measure the amount of actual radicals introduced into the plasma. One would have been motivated to do so in order to obtain the most accurate density of the plasma for additional processing steps (i.e. flow rate of radicals).

8. Claim 62 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hiramatsu in view of Nagasawa and Ravi and further in view of Merkulov [US 6649431].

Teaching of Hiramatsu in view of Nagasawa and Ravi is aforementioned, but appears to be silent in varying the ratio of the feed rate of a carbon source material (such as carbon and fluorine) and that of another material containing carbon and hydrogen. Merkulov remedies this.

Regarding claim 62, Merkulov teaches a carbon structure contains an expanded base on the substrate (i.e. varying the properties of the carbon structure) by adjusting the ratio of carbon source gas to an etchant gas [claim 1], wherein the etchant gas may be acetylene [ col 4, ln 57-60].

It would have been obvious to one of ordinary skill in the art at the time of the invention to adjust the ratio of carbon source gas to an etchant gas as suggested by Merkulov. One would have been motivated to do so to fabricate a desirable property (i.e. shape) from the carbon nanostructure.

9. Claim 64 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hiramatsu in view of Lee [US 20020046953].

Teaching of Hiramatsu is aforementioned, but appears to be silent in teaching the limitation of orientating the nanostructure by tilting a line normal to the base material with respect to the direction of the electric filed. Lee remedies this.

Regarding claim 64, Lee teaches the carbon structures may be orientated in the direction of a plasma discharge (i.e. electric field) wherein by either tilting the substrate or electric source, the carbon structures may be formed at other angles to the substrate [0071].

It would have been obvious to one of ordinary skill in the art at the time of the invention to orient a nano structure by tilting an electric field source. One would have been motivated to do so to achieve a tilt orientation if so desired (depended upon the function of the nanostructure in a device).

***Conclusion***

1. No claim is allowed.
2. All the pending claims are subject to restriction/election requirement.
3. Claims 46-53 and 65-74 are withdrawn from restriction election.
4. Claims 38-45 and 54-64 are rejected for the reasons aforementioned.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MANDY C. LOUIE whose telephone number is (571)270-5353. The examiner can normally be reached on Monday to Friday, 7:30AM - 5:00PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571)272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/M. C. L./
Examiner, Art Unit 1792

/Timothy H Meeks/
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